

# REPORT DOCUMENTATION PAGE

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During the months of February and March, 1993, the JASON Foundation for Education and the Woods Hole Oceanographic Institution conducted a joint investigation of the hydrothermal vents in Guaymas Basin. The JASON Project also conducted a separate investigation of the gray whale population at San Ignacio Lagoon.			
The primary objective of the JASON Project was to use advanced telecommunication technology to provide 750,000 students across No. America, Bermuda, Mexico, and Europe with the opportunity to participate in "live" scientific exploration and discovery. There were 58 live JASON Project broadcasts during the expedition period.			
The primary goal of the Woods Hole Program was to use the remotely operated vehicle system JASON and the manned submersible TURTLE to carry out a multidisciplinary investigation of the hydrothermal vents situated in Guaymas Basin.			
What follows is a series of summary reports which explain in greater detail the results of the individual science programs.			15. NUMBER OF PAGES 23
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Woods Hole Oceanographic Institution  
Woods Hole, MA 02543  
Phone: (508) 548-1400  
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November 21, 1995

Scientific Officer  
Office of Naval Research  
Code 452  
Ballston Tower One  
800 North Quincy Street  
Arlington, Virginia 22217-5660  
Attn: CDR William A. McIsaac  
Ref: Contract N00014-93-1-0057 and N00014-89-D-0255-0004

Dear CMD McIsaac:

Attached is the final report for ONR contracts **N00014-93-1-0057** and **N00014-89-D-0255-0004**. Both contracts were to support the *Jason Project Voyage IV at Guaymus Basin*. Each participating scientist provided a report that was summarized by Dr. Ballard.

Sincerely,

*Larry D. Flick*  
Larry D. Flick  
Center Administrator  
Deep Submergence Laboratory

*199510200000*

xc: Mr. Robert Tanner (copies - 2)  
Director, Naval Research Laboratory (copies - 2)  
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**JASON PROJECT VOYAGE IV REPORT  
BY  
DR. ROBERT D. BALLARD  
CHIEF SCIENTIST  
CRUISE NO. 92-037  
DIPLOMATIC NOTE #00245**

**SUMMARY**

During the months of February and March, 1993, the JASON Foundation for Education and the Woods Hole Oceanographic Institution conducted a joint investigation of the hydrothermal vents in Guaymas Basin. The JASON Project also conducted a separate investigation of the gray whale population at San Ignacio Lagoon.

The primary objective of the JASON Project was to use advanced telecommunication technology to provide 750,000 students across North America, Bermuda, Mexico, and Europe with the opportunity to participate in "live" scientific exploration and discovery. There were 58 live JASON Project broadcasts during the expedition period.

The primary goal of the Woods Hole Program was to use the remotely operated vehicle system JASON and the manned submersible TURTLE to carry out a multidisciplinary investigation of the hydrothermal vents situated in Guaymas Basin.

In addition to U.S. scientists, the research team included scientists from a number of Mexican Institutions who also participated in the diving program aboard TURTLE, observed the work being carried out by the ROV JASON and participated in the JASON Project broadcasts.

What follows is a series of summary reports which explain in greater detail the results of the individual science programs.

## Attachment B.

Individual Science Reports of JASON Project Participating Scientists.  
The Reports include Data Observations, Samples Collected, & Schedule of Delivery  
for all Data Results & Reports.

Reports attached in the following order:

- Veronique Robigou, University of Washington, School of Oceanography
- Dr. W. Kenneth Stewart, WHOI
- Dr. Margaret Tivey, WHOI
- Dr. Jeffrey Seewald, WHOI
- Dr. Bernd R.T. Simoneit, Oregon State University, College of Oceanic and Atmospheric Sciences
- Dr. Laurence P. Madin, WHOI
- Dr. Holger Jannasch, WHOI/Carl Wirsen, WHOI
- Dr. John Edmond, MIT and Henrietta Edmonds, MIT
- Dr. Richard A. Lutz, Rutgers University in collaboration with Dr. Robert Vrijenhoek
- Dr. Fred Grassle, Rutgers University/Rose Petrecca, Rutgers University
- Dr. Jim Sumich, Grossmont College/Dr. Jim Harvey, Moss Landing Marine Labs

**UNIVERSITY OF WASHINGTON**  
*School of Oceanography WB-10*  
Seattle, Washington 98195

April 9, 1993

Dr. Robert Ballard, Chief Scientist/JASON Project  
Scientific Research approved in Diplomatic Note #00245, February 4, 1992

**Preliminary Report  
for JASON Project IV  
Sea of Cortez - Guaymas Basin Hydrothermal Site  
February 21 - March 14, 1993**

**Detailed Mapping/Geological Survey**

V. Robigou  
University of Washington  
School of Oceanography WB-10  
Seattle, WA 98195  
(206) 543-9282

The research site chosen for the JASON ROV-TURTLE submersible combined operations is located in the southern through of the Guaymas Basin of the Sea of Cortez at 27°00.500 N and 111°24.600 W. It is the southernmost extension of the known active hydrothermal vent sites previously described by Lonsdale et al. in 1980.

The mapping survey operations took place from Feb. 23 to Feb. 28 and the detailed geological investigations of specific active sites from Feb. 28 to March 13, 1993.

The data collected includes navigation (Long Base Line) and bathymetry (Metotech sector scanning sonar) for an area 200 m x 250 m which contains four main hydrothermal active sites.

On each of these sites high quality video coverage from both 1-chip and 3-chip video cameras was collected to produce a general geologic map of the area surveyed.

Finally, high-precision (cm) navigation data (using the EXATC navigation system), detailed video coverage and electronic still camera images (1000 x 1000 pixels) were collected on the most interesting hydrothermal site in order to provide a high-precision bathymetric and geologic map of the site on which other experiments were planned. These included high temperature fluids measurements, biological sampling, geological sampling etc...

This geological mapping effort was the first mapping effort at this scale and high-precision attempted in the Guaymas Basin hydrothermal site.

We expect submitting a final report on this phase of the scientific program to the Mexican government by the end of April 1995 as a publication in a scientific journal.

## Multiscale, Multisensor Mapping During the 1993 JASON Project

Dr. W. Kenneth Stewart

Department of Applied Ocean Physics and Engineering  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

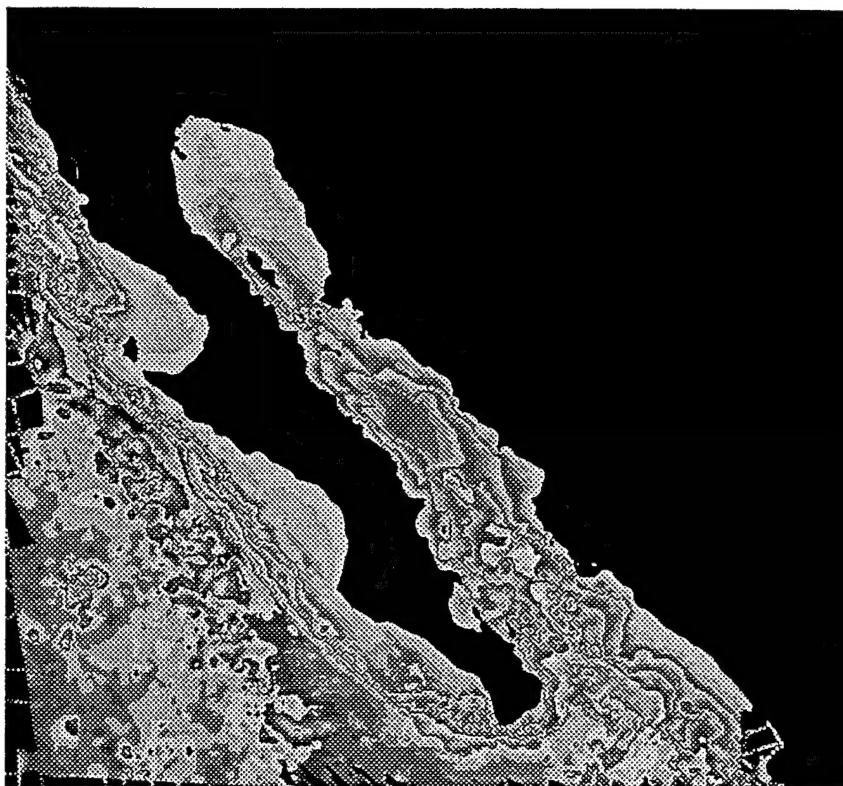
13 April 1993

**Chief Scientist:** Dr. Robert Ballard, JASON Project.  
**Authorization:** Scientific Research approved in Diplomatic Note number 00245,  
4 February 1992.  
**Research Site:** JASON Project Site, Guaymas Basin, Sea of Cortez.  
**Dates of Research:** 21 February 1993 - 27 February 1993.  
**Type of Research:** Acquisition and processing of multiscale, multisensor data for the  
purpose of creating maps and real-time displays.

### Description

During the week preceding the start of Project broadcasting, we undertook the task of creating a multiscale, multisensor spatial database that could be used to generate maps, images, and real-time displays for scientists and operators using the JASON ROV. This entailed collecting a sequence of data sets from different remote sensors, merging these data with vehicle navigation and attitude measurements, then processing the merged data sets with custom software developed at the Woods Hole Oceanographic Institution.

Prior to the cruise, the largest scale data were assembled by digitizing contours from historical charts, which mainly comprised single-beam soundings. The contour data were then rasterized to produce a digital bathymetric grid of the Sea of Cortez, Baja Peninsula, and adjacent segments of the Mexican mainland and Pacific Ocean (Fig. 1). The nominal resolution of this grid is about 1000 m horizontally and 100 m vertically.



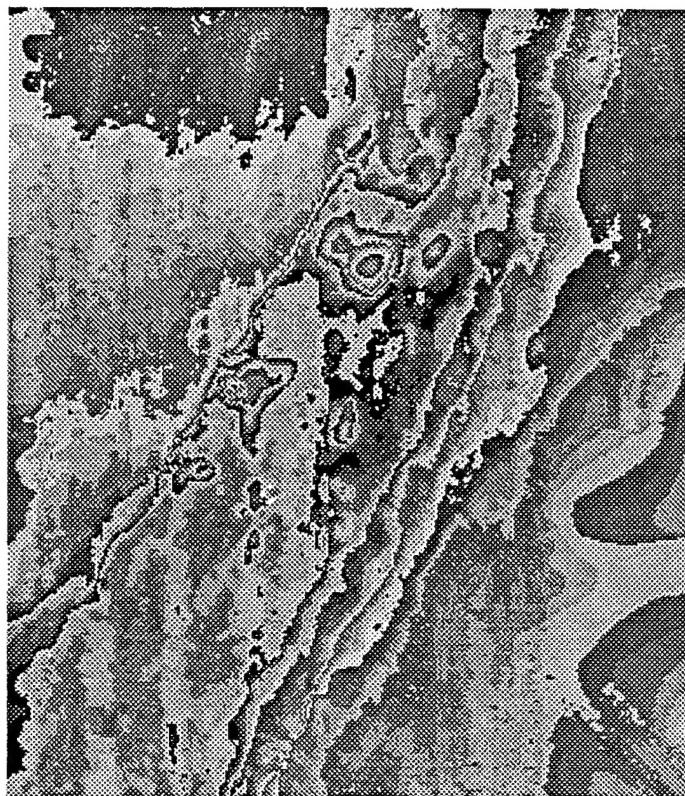
**Figure 1.** Historical grid showing Sea of Cortez and Baja Peninsula. (Terrestrial data are shown in black; grey-scale approximates the original color contours.)

After arrival at the site, a multibeam bathymetric survey was conducted using a Sea Beam sonar permanently installed on the vessel Laney Chouest with navigation provided by the Global Positioning System (GPS). The initial survey, centered on the Project site, entailed about 6 hrs of mapping over an area 6-km square (Fig. 2). The nominal resolution of this grid is about 100 m horizontally and 10 m vertically.

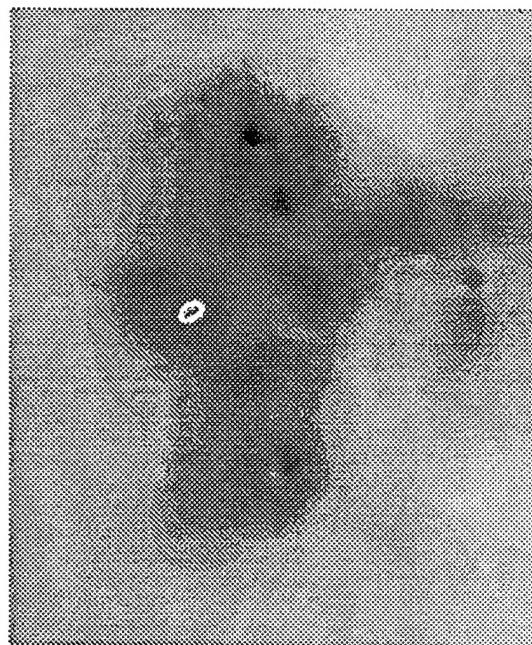
After processing the Sea Beam survey data aboard ship, the resulting bathymetric map was used to select a site for an intermediate-resolution survey, which dictated the location of long-baseline (LBL) transponders to establish a subsea navigation framework. The LBL network was deployed and surveyed using GPS, which provided subsea navigation accuracy of about 3 m.

Within this framework, the JASON ROV was deployed to locate sulphide mounds within the intermediate-scale area. For this purpose, a survey was conducted using a 675-kHz Mesotech scanning sonar mounted on the ROV. These data were merged with LBL navigation and vehicle attitude measurements then processed to generate a spatial database about 200 x 250 m in extent (Fig. 3). The nominal resolution of this grid is about 5 m horizontally and 1 m vertically.

After selecting the northernmost mound (designated Mound 4) as the focal site for most experiments, a precision LBL system (EXACT) was deployed and calibrated with sing-around techniques. EXACT provided localized (ranges less than 100m) subsea navigation with an



**Figure 2.** 6 x 6 km Sea Beam grid centered on the JASON Project site. (Grey-scale approximates the original color contours.)



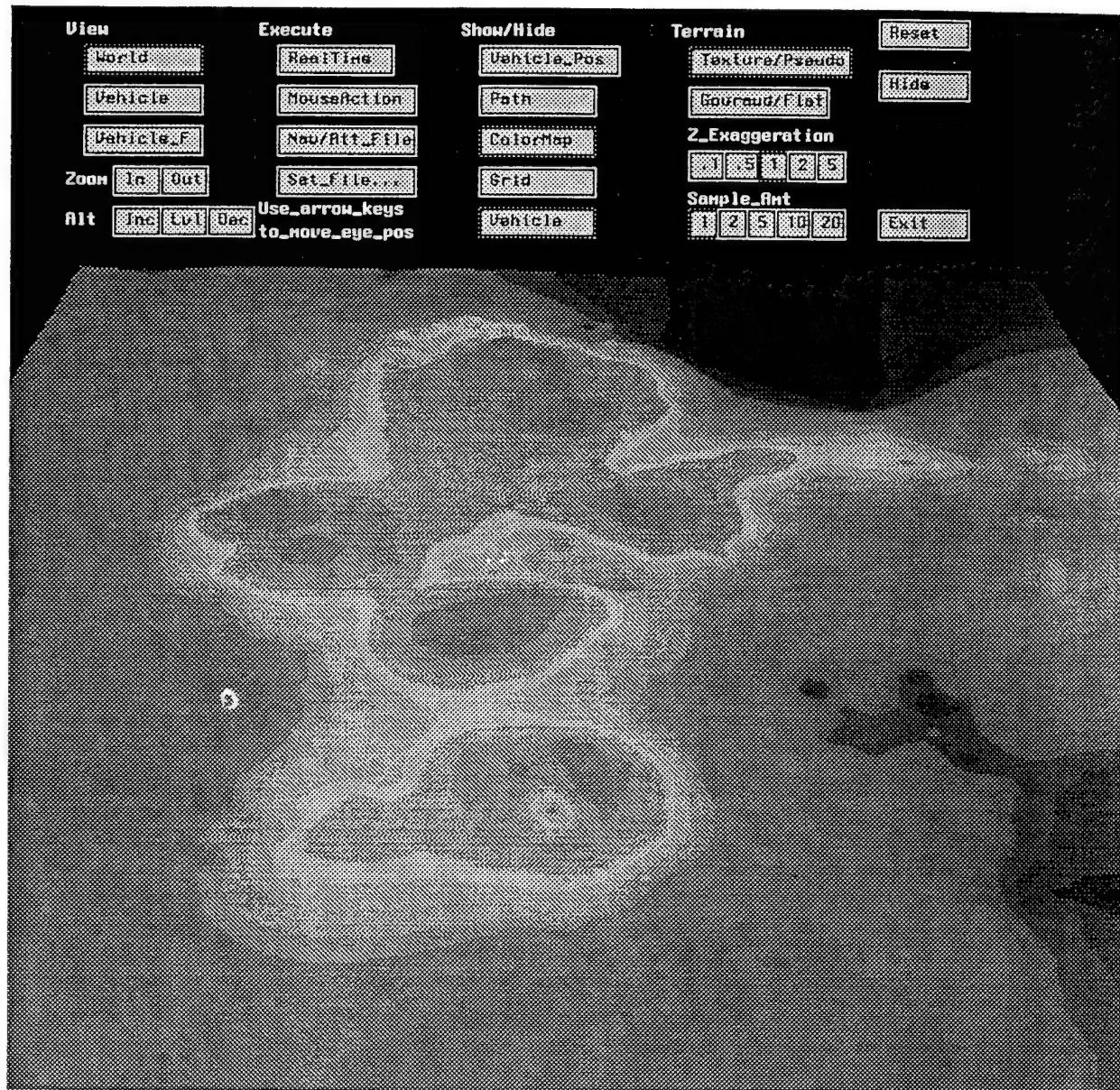
**Figure 3.** 200 x 250 m Mesotech grid of the intermediate-scale area. Lighter colors represent greater depth; darker colors show higher relief sulphide mounds.

accuracy of about 5 cm. Figure 4 shows the result of a high-resolution survey of Mound 4 using the EXACT navigation system and Mesotech sonar deployed from the JASON ROV. The survey area is 24 x 22 m with a nominal resolution of 10 cm horizontally and vertically.



**Figure 4.** 24 x 22 m Mesotech grid of Mound 4. Lighter colors represent greater depth; darker colors show higher relief pagoda atop the mound.

After processing grids, data were distributed over the satellite Internet link to various locations ashore that participated in the program remotely. Real-time navigation and attitude data were then transmitted on a continuous basis to network nodes at sea and ashore. These data drove two- and three-dimensional displays of the JASON ROV, showing the vehicle in real-time perspective within the context of actual local morphology (Fig. 5).



**Figure 5.** 3-D perspective view from a real-time visualization of the JASON ROV within the intermediate-scale survey area. (Grey-scales approximate the original color contours.)

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Woods Hole Oceanographic Institution

Woods Hole, MA 02543

Phone: (508) 548-1400

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Preliminary report on Flange studies,  
Guaymas Basin, Sea of Cortez  
submitted by Margaret K. Tivey  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543 USA

Dr. Robert D. Ballard, Chief Scientist/JASON Project      Cruise No. 92-037  
Scientific Research approved in Diplomatic Note number 00245, February 4, 1992

Research site:

Vent field in Guaymas Basin, Sea of Cortez, mapped by Veronique Robigou and others;  
specifically G, or Gulf, and E, or Echo, Clumps.

Dates of research: March 7, and 9-12, 1993

Type of research:

Development of flanges (chimney eaves) that project tens of centimeters from the sides of hydrothermal vent structures in the Guaymas Basin will be compared to those found at the Endeavour Main Field, Northern Juan de Fuca Ridge. JASON was used to collect video imagery, and to record temperatures on all exposed surfaces, of a flange in G, or Gulf Clump, Guaymas Basin. TURTLE was used to break off and recover small pieces of the flange for detailed geochemical and petrographic examination, and to collect a fluid sample from the underside of the flange. In addition, a small piece of a flange from E, or Echo, Clump was also recovered. The resultant data set, comparable to an existing data set from the Endeavour Main Field site, will be used to constrain boundary conditions for modeling flange growth. The opportunity to have two similar datasets from two distinct sites with different mineralogies and fluid compositions should greatly enhance the ability to constrain those variables thought to control flange development.

Activities undertaken:

On March 7, 1993, TURTLE was used to:

a) recover a small piece of a flange from E Clump (sample T728-29-93 rock 1)

On March 9, 10, 11, and 12, 1993, JASON was used to:

a) collect high quality video imagery of the flange in G Clump

b) measure temperature (and document the location of the temperature probe using video) in a grid pattern on all surfaces of the flange, including the underside (282°C)

On March 11, 1993, TURTLE was used to:

a) break off and recover a small piece of the flange (sample T731-32-93) in G Clump  
b) record video imagery of the flange after it was broken

On March 12, 1993, TURTLE was used to:

a) sample fluid from the underside of the flange in G Clump  
b) break off and recover another small piece of the flange (sample T732-33-93)  
c) record video imagery of the flange after it was broken

Sample numbers and brief descriptions:

T728-29-93 rock 1:

Piece of flange from E Clump that broke into 1 larger piece (18x10x5cm) and 10 smaller pieces. All pieces are composed primarily of mixed pyrrhotite and anhydrite.

T731-32-93 rock 1:

Piece of flange from G Clump (pooled fluid was 282°C) that broke into 1 larger piece (10x6.5x3cm) and 1 smaller piece. Pieces are composed primarily of anhydrite with some fine inclusions of sulfide.

T732-33-93 rock 1:

Piece of same flange sampled on dive T731-32-93 that broke into 1 large piece (18x15x4cm), 6 small pieces (<10 cm largest dimension), and many smaller (<3 cm) pieces. Same mineralogy as T731-32-93.

The fluid sample collected on dive T732-33-93 will be analyzed by Henrietta Edmonds and John Edmond.

Submission of final report is anticipated by the end of the year (depending on funding).

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Cruise No. 92-037

Preliminary Report - Jason Project  
April 26, 1993

Dr. Robert D. Ballard, Chief Scientist/JASON Project  
Scientific Research approved in Diplomatic Note number 00245, February 4, 1992.

*Scientist* - Dr. Jeffrey Seewald  
Woods Hole Oceanographic Institution  
Fye Laboratory  
Woods Hole, MA 02543  
USA

*Research Site* - Guaymas Basin

*Dates of Research* - Sample #Turtle 730-31-93 was collected on March 9, 1993

*Type of Research* - A single push core sample of unaltered surface sediment was collected by Turtle for my research during the JASON project. This sediment will be used for hydrothermal experiments in the laboratory to constrain better factors that regulate the generation and stability of organic compounds and the extent and nature of organic-inorganic interactions in natural hydrothermal systems. The experiments will be used to calibrate geothermometers based on the relative abundance and distribution of thermally altered organic species for use in ridge crest hydrothermal systems. The ultimate goal of this work is to evaluate geochemical conditions during hydrothermal sediment alteration and to constrain the time-temperature history of sediment-covered spreading centers.

*Final Report Date* - No research has yet been conducted with the sample collected. Experiments utilizing the sediment will be performed during the next two years at Woods Hole Oceanographic Institution. When the study is completed a final report will be submitted.

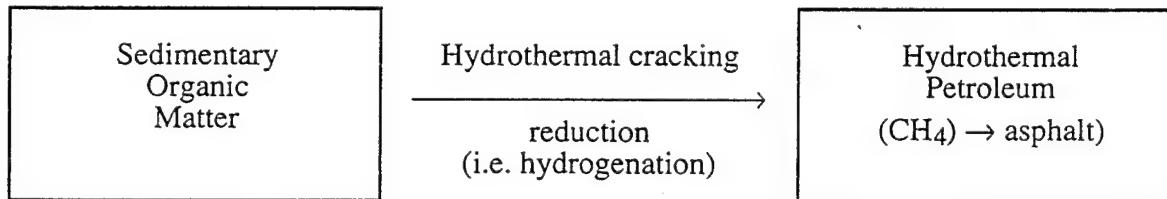
## Preliminary Science Report – JASON IV Project in Guaymas Basin, Hydrothermal Petroleum Research (continuing research)

Bernd R. T. Simoneit  
 College of Oceanic and Atmospheric Sciences  
 Oregon State University  
 Corvallis, OR 97331-5503, USA

Cruise to Sea of Cortez, March 1–4, 1993  
 Dr. Robert D. Ballard, Chief Scientist/JASON Project  
 Scientific Research approved by Diplomatic Note number 00245, February 4, 1993

### BACKGROUND

Guaymas Basin and its associated hydrothermal vent fields provides hydrocarbon geochemists with a unique opportunity to study the formation of hydrothermal petroleum. The fact that the rift axis and site of magma injection are covered by organic-rich sediment, through which hydrothermal fluids migrate to the surface, leads to the formation of hydrothermally generated organic compounds (petroleum). The precursor sedimentary organic matter ("organic carbon") consists of biodegraded and non-biodegraded detritus from plankton and microbes. It is composed of gases, lipids (fats), pigments (e.g. chlorophyll, carotenoids), carbohydrates, protein residues, biomembranes and many other classes of organic materials. Hydrothermal activity causes alteration of this organic matter as shown in the schematic:



Hydrothermal petroleum is a mixture of  $\text{CH}_4$  (methane), ethane, etc. to heavy hydrocarbons and asphalt. One objective of the JASON IV Project was to acquire various samples of liquid oils, condensates and oil-water emulsions from this system to be able to understand the behavior of these hydrocarbons in the hydrothermal fluids. This information is necessary to model solvent capacity, cosolubility, extraction efficiency, density, salting-out, near- and supercritical states, migration rates and reactivity of the hydrothermal fluid mixtures of organic and inorganic components.

### RESULTS

Ten different types of samples containing oil were recovered on DSV *Turtle* dives. All are typical oils as recovered on earlier cruises to the area, except one sample was the liquid hydrothermal petroleum with all the components retained as they bubbled out at the seabed of Guaymas Basin. The sample was trapped in an upside-down tube, and water was allowed to bleed

off as the pressure decreased during ascent, resulting in expansion of the volatile hydrocarbons ( $\text{CH}_4$  to  $\sim\text{C}_{10}\text{H}_{27}$ ) into a gas phase. Just before surfacing the pilot pushed the tube into a stopper to seal the bottom. On deck the three phase sample was recovered and preserved for analysis. It has a calculated volume of  $2.5 \text{ cm}^3$  on the seafloor and a two phase volume ratio of 178 for gas/oil at the sea surface. A similar sample taken in 1986 had a gas/oil ratio of 5 (Simoneit et al., 1988), indicating that the oils venting at the seafloor have wide variations in compositions with some extremely rich in volatile hydrocarbons. The liquid oil samples were preserved for detailed analysis in the laboratory at OSU. Collaborative assistance was provided by Adm. Alberto M. Vazquez de la Cerdá, Secretaría de Marina, Dirección General de Oceanografía Naval, Mexico.

#### REFERENCE

Simoneit, B.R.T., O.E. Kawka and M. Brault (1988). Origin of gases and condensates in the Guaymas Basin hydrothermal system (Gulf of California). In: Proc. Symp. *Origins of Methane in the Earth*, M. Schoell (ed.). *Chem. Geol.* **71**, 169-182.

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JASON PROJECT 1993 Preliminary Research Report

Laurence P. Madin  
Woods Hole Oceanographic Institution  
Woods Hole, MA 025453  
508-457-2000 ext 2739  
April 8, 1993

Dr. Robert D. Ballard, Chief Scientist/JASON Project  
Scientific Research approved in Diplomatic Note number 00245, February 4, 1992.

Research Site: Guaymas Basin hydrothermal vent field, conducted from R.V. Laney Chouest.

Dates of Research: March 5-13, 1993

Type of Research: Investigation of the composition and distribution of the benthopelagic fauna (invertebrate zooplankton and fishes) in the vicinity of the hydrothermal vents. This work will provide data for comparison with other non-vent sites studied previously.

Research Activities Undertaken: Direct video observations and videotape recordings will be used to identify plankton and fishes and estimate their numerical abundances to the extent possible. Collections of some invertebrate plankton were made with a suction sampler on the JASON vehicle. Specimens of *Atolla wyvillei*, *Benthocodon pedunculata*, *Poralia rufescens* and *Peniagone diaphana* were photographed and preserved for further examination.

Date of Final Report: These data will be used with other results from other sites in a paper on benthopelagic community structure. I anticipate that this manuscript will be available in mid 1994.

**PRELIMINARY REPORT ON MICROBIOLOGICAL WORK (JANNASCH/WIRSEN)  
CONDUCTED DURING THE JASON PROJECT**

Dr. Robert D. Ballard, Chief Scientist/JASON Project, Scientific Research approved by Diplomatic Note no. 00245, February 4, 1992.

**Research Site:**

Southern Trough- Guaymas Basin - Gulf of California, 27°01' N x 111°24' W

**Dates of Research Period:**

February 21 to March 6, 1993

**Type of Research:**

Our research represented a continuation of previous work conducted at the Guaymas Basin with the R/V ATLANTIS II/DSRV ALVIN during July-August, 1985 (voyage #112, legs 27 and 28), January-February, 1988 (voyage #118, leg 28) and March, 1991 (voyage #125, legs 22 and 23). The research concerned the measurement of chemosynthetic activity of the massive bacterial mats (*Beggiatoa* sp.) covering certain parts of sediment and the surface of mineral sulfide deposits. In addition, bacterial enrichments from oily sediment and polymetal sulfides were done for the possible isolation of hydrocarbon degrading bacteria and hyperthermophilic archaea which grow temperatures of up to 103°C.

**Description of Activities Undertaken:**

**A. Samples:** Samples of sediment were collected by tube coring (one core collected by JASON and three by TURTLE) and were used for microbial enrichments on board ship. The remaining sediment was saved in jars for further experimentation in the home laboratory. Three samples of rock or polymetal sulfides were collected on TURTLE dives. Two of these represent extinct smoker chimney material and one a heavily oil laden piece of mineral sulfide. Scrapings from these hydrothermal mineral sulfides were used to inoculate a variety of bacterial media for enrichment of thermophilic bacteria.

As a primary JASON task it was planned to operate a multi-chambered slurp gun newly constructed for this cruise. The instrument was designed to facilitate in situ time course measurements of chemosynthetic activity (CO<sub>2</sub> fixation) by the mat bacteria *Beggiatoa*. Due to engineering problems this sampler was not assembled or used on the cruise. As a back-up instrument, we used our old slurp gun device with a pump and motor operated by JASON. This arrangement secured us one sample of enough *Beggiatoa* material to conduct a shipboard experiment.

**B. Data Collected:** Positive enrichments of hyperthermophilic bacteria and several pure cultures were obtained in the home laboratory. Although enrichments were positive, no naphthalene or tolulene degrading microorganisms have been obtained as yet. The chemosynthetic activity of collected *Beggiatoa* filaments was measured as DPM over the course of 12 hours. A plot (enclosed) of the data shows a relatively rapid rate of carbon dioxide fixation.

**Expected Date for Submission of Final Report:**

We hope to be able to submit the final report by the end of the year (November or December 1993). Because of the fact that the rotary slurp gun was not completed in time, the data to be expected for the final report will concern only: work with thermophilic bacterial isolates and the possible isolation of hydrocarbon degrading bacteria and possibly some experimental work conducted with the collected oil containing sediments. Some of this planned research will depend on future funding.

Submitted By:

Dr. Holger W. Jannasch and Carl O. Wirsen  
Biology Department, Woods Hole Oceanographic Institution

To: Crissy Torruella  
JASON Foundation for Education

From: Henrietta Edmonds - MIT /Dr. John Edmond- MIT

Date: April 14, 1993

Re: JASON Project IV Preliminary Report

Dr. Robert D. Ballard, Chief Scientist/JASON Project  
Scientific Research approved in Diplomatic Note number 00245, February 4, 1992

Preliminary Report on Investigations of Hydrothermal Vent Fluid Chemistry at the  
Guaymas Basin, March 1993

Research into the fluid chemistry of hydrothermal vents in the Sea of Cortez was conducted as part of the JASON Project IV expedition of 1993. This study is a continuation of the investigations of Professor John M. Edmond of the Massachusetts Institute of Technology, who has visited and sampled the Guaymas Basin vents (with the DSRV *Alvin*) in 1982, 1985, and 1988. The goal of the present sampling was to extend the temporal record of the chemistry of these hydrothermal vents, to assess their stability (or possibly their evolution), and to clarify the unique chemical characteristics of this site relative to other hydrothermally active areas.

Henrietta Edmonds of MIT was on board the *Laney Chouest* in the Sea of Cortez from March 4 through March 13, 1993. Two samples of vent water were collected from DSV *Turtle*, the first on Sunday, March 7 (*Turtle* dive #728-29-93), and the second on Friday, March 12 (*Turtle* dive #732-33-93). The first sample was collected from a "black smoker" vent located at mound Echo of the hydrothermal field. The second sample was collected from underneath a sulfide flange structure at clump Golf, with a measured temperature of 282 °C. Analysis of sample pH and alkalinity was performed on board the ship within a few hours of sample recovery. The remainder of the water (approximately 1.5 liters from each sample) was transported back to MIT for future analysis. To date, dissolved silica and chlorinity measurements have been completed. The remaining analysis of major ions is expected to be completed within the next few months.

Dr. Robert D. Ballard, Chief Scientist/JASON Project  
Scientific Research approved in Diplomatic Note number 00245, February 4, 1992

Preliminary Report  
Richard A. Lutz

**RESEARCH SITE:** Guaymas Basin Hydrothermal Field located at approximately  
Lat. 27°00' N, Long. 111°24'W

**DATES OF RESEARCH:** February 25 - March 5, 1993

**TYPE OF PROJECT:** Our research efforts are a continuation of previous work  
conducted in Guaymas Basin concerning genetic analysis  
of organisms encountered at deep-sea hydrothermal vents  
and analysis of rates of molluscan shell dissolution.

**DESCRIPTION OF ACTIVITIES UNDERTAKEN:**

Tissues from six vesicomyid clams and 75 tube worms were frozen from specimens  
collected at the Guaymas hydrothermal vent site located at approximately Lat. 27°00' N,  
Long. 111°24'W in order to perform population genetic studies. The overall goal of the  
project is to assess rates of gene flow among (and systematic relationships between)  
organisms from various hydrothermal areas. Four experiments were also deployed at the  
vent site to assess rates of dissolution of molluscan shells.

Tissues from the collected organisms were frozen at -70°C in an ultra-low freezer.  
Samples of specimens collected during the cruise were distributed to Mexican participants  
on board the ship. All frozen material will be stored at Rutgers University (R. Lutz and R.  
Vrijenhoek, custodians). Genetic and dissolution data will be analyzed and summarized  
over the next 4 years, as part of our ongoing studies funded by the National Science  
Foundation.

**MEXICAN COLLABORATORS:**

In our studies of calcium carbonate dissolution at the Guaymas Basin hydrothermal site, we  
are collaborating with Drs. Adolfo Molina-Cruz and Adriana Lilia Ayala-Lopez.

**INFORMATION ADDRESS:**

Institute of Marine and Coastal Sciences  
Dudley Road  
Cook College  
Rutgers University  
New Brunswick, NJ 08903

**SCHEDULE OF DELIVERY OF FINAL REPORT:**

We expect to submit a final report at the conclusion of our NSF-related studies which are  
scheduled to terminate in December, 1996.

1993 JASON Project

Preliminary Report

J.F. Grassle, R.F. Petrecca (Rutgers), and V. Solis-Weiss (UNAM)

Guaymas Basin is the best-known sedimented hydrothermal site. The patchy appearance of the soft sediments represents varying degrees of hydrothermal influence. Only a few animal species survive in the most extreme of these hydrothermal environments under conditions that would kill most marine life. Because of high microbial productivity the density and biomass of these few species is very high. As the flux of hydrothermal fluid and consequent rate of productivity declines more species can survive even though the density, size of animals and biomass declines. The most hospitable environment for the great variety of deep-sea life forms is found in soft-sediments away from sources of hydrothermal energy.

Our main objective on this 1993 JASON Expedition was to collect sediment samples for infaunal analyses. The different locations where these samples were taken represent actual hydrothermal venting sites; other areas with thick overlying Beggiatoa mat; and ambient sediment areas.

A total of 16 qualitative tube cores and one box core ( $225 \text{ cm}^2$ ) were collected on this cruise. Two tube cores were collected by JASON while sampling at one of the hydrothermal vent sites. The remainder of the tube cores and the 1 box core were collected by the DSRV TURTLE on Dives #2 to 9. A clump of black coral was collected by V. Solis-Weiss on TURTLE Dive #7.

A main objective of the DSRV TURTLE was to survey several previously known vent sites (several to tens of kilometers apart) in the southern trough region. During these surveys new venting sites were discovered so our overall knowledge of the hydrothermal venting system at Guaymas has been expanded.

JASON's detailed imaging system in conjunction with the EXACT navigational system will significantly enhance the overall description of the hydrothermal vent megafauna.

The sediment samples collected on this expedition will be analyzed by F. Grassle, R. Petrecca and V. Solis-Weiss. The infauna data will be combined with data collected at this hydrothermal vent site from previous ATLANTIS II/ALVIN expeditions in 1983, 1985, 1988 and 1991.

Dr. Robert Ballard, Chief Scientist/JASON Project  
Scientific Research approved in Diplomatic Note # 00245, February 4, 1993

## Preliminary Research Report

### Principal Investigators

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### Study site and dates

Field studies were conducted in Laguna San Ignacio, Baja California Sur, Mexico, between 19 February and 14 March, 1993. The purposes of this study were to characterize ventilatory patterns of young unrestrained gray whale calves (*Eschrichtius robustus*). Most of the research was conducted from Mexican-operated pangas powered by outboard motors. Some components of this research depended on close approaches and direct physical contacts with curious or friendly calves.

### Oxygen extraction

Estimates of oxygen consumption rates were made by determining fractions of extracted oxygen and of breathing rates. A gas capture system consisting of evacuated 5 L latex meteorological balloons attached to short sections of rigid PVC pipe were used to collect expired lung air opportunistically from friendly calves. Thirty-one acceptable samples were obtained from 9 calves, with a maximum of 8 samples from one calf. Values of % oxygen extracted ranged from 4-15%. A strong correlation was found between % oxygen extracted and the breathhold duration prior to the samples expiration.

### Radio transmitter tags

For extended duration samples of ventilatory and diving behavior, small VHF radio transmitters (Advanced Telemetry Systems) were temporarily attached with rubber suction cups to four calves. The tags were attached from the end of a placement pole when calves approached the panga. Signal monitoring was done from shore with a directional antenna array and from pangas with a hand-held receiver unit. Total number of monitored dives exceeded 1200. Tag loss was greater than expected, with a maximum attachment time of about nine hours.

### Aerial photogrammetry

Attempts to measure body sizes of specific study animals from vertical still photographs taken from a single-engine high-wing aircraft on March 7 and March 9 failed due to poor water clarity.

**Photographic I.D.**

Numerous still and video images of adult gray whales in Laguna San Ignacio were obtained opportunistically by several Project participants. When collected and organized, these images will be compared to the photographic images collected by MaryLou Jones and Steven Swartz in Laguna San Ignacio between 1977 and 1981 for possible long-term lagoon utilization patterns.

**Lagoon censuses**

Two complete and one partial lagoon surveys of gray whales were made from pangas using four observers. The two complete surveys counted 60 calves and 140 non-calves on February 20 and 93 calves and 138 non-calves on February 27. A survey on March 13 was stopped due to windy conditions.

**Participating Mexican Scientists**

Ivonne Vomend, Mexico, D.F., Mexico

Octavio Maravilla Chavez, PESCA, La Paz, B.C.S., Mexico

Copies or summaries of all data collected will be available from the Principal Investigator to interested researchers. Grossmont College will be the repository for all still film images obtained for photographic I.D. purposes.

Four copies of a written final report, including published articles, will be provided within one year of the completion of research.